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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/802,150

03/17/2004

Keun-Hee Bai

8021-215 (SS-19582-US)

3946

22150 7590 02/12/2008  
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EXAMINER

RAYMOND, BRITTANY L

ART UNIT

PAPER NUMBER

1795

MAIL DATE

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/802,150	<b>Applicant(s)</b> BAI ET AL.	
	<b>Examiner</b> Brittany Raymond	<b>Art Unit</b> 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 28 November 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-17,19-21,23 and 24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-3,5-17,19-21,23 and 24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
  2. Ascertaining the differences between the prior art and the claims at issue.
  3. Resolving the level of ordinary skill in the pertinent art.
  4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
2. Claims 1, 2, 5, 6, 9, 10, 12, 13, 15-17, 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (U.S. Patent Publication 2004/0192058) in view of Ma (U.S Patent 6830877).

Chu discloses a pattern forming method comprising: placing an etch stop layer on a substrate (Paragraph 0017), forming a dielectric insulating layer of the etch stop layer (Paragraph 0018), depositing an anti-reflective coating over the insulating layer (Paragraph 0020), placing a photoresist layer over the anti-reflective coating and carrying out a photolithographic process (Paragraph 0021), placing a second photoresist layer over the substrate, patterning the second photoresist layer (Paragraph 0023), exposing the patterned photoresist to a carbon monoxide containing plasma to

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form a polymer layer on the surface of the photoresist layer (Paragraph 0024), etching the substrate with fluorocarbon gas, using the hardened photoresist layer as a mask (Paragraph 0028), and performing an oxygen ashing process to remove the photoresist layer (Paragraph 0029), as recited in claims 1, 2, 5, 6, 9, 10, 12, 13, 15-17, 21 and 23 of the present invention.

Chu fails to disclose that an ArF photoresist material is used.

Ma discloses a method for forming via and contact holes with a photoresist comprising imaging a photoresist material using an argon fluoride laser source since a 193 nm source is required (Column 2, Lines 7-11), as recited in claims 1, 9, 12, 15 and 21 of the present invention.

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have used an ArF photoresist, as suggested by Ma, in the process of Chu because Ma teaches that ArF light sources are a common type of deep ultraviolet light used in photolithography processes.

3. Claims 1, 2, 5-10, 12, 13, 15-17, 19-21, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lindley (U.S. Patent 6326307) in view of Meyer (U.S. Patent 4504574) and Ma (U.S. Patent 6830877).

Lindley discloses an etching process comprising: providing a substrate with several metallization layers (Column 1, Lines 13-14), placing a photoresist layer on top of the oxide layer and patterning it to form a mask for etching (Column 4, Lines 62-64), pretreating the patterned photoresist layer and etching the metallization layers (Column 4, Lines 64-66), as recited in claims 1, 9, 12, 15 and 21 of the present invention.

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Lindley states that the etching is performed with a fluorocarbon plasma, as recited in claims 6, 9, 12 and 21 of the present invention. Since the layers are being exposed to fluorocarbon plasma during the etching process, this means that fluorine radicals are present during etching, as recited in claims 5 and 15 of the present invention. Lindley discloses that a dielectric layer, such as silicon dioxide, is typically used as one of the metallization layers being etched (Column 1, Line 15-16), as recited in claims 1 and 17 of the present invention. Lindley states that a polymer layer is formed over the top of the photoresist layer and the photoresist sidewalls during the fluorocarbon treatment (Column 3, Lines 55-56), as recited in claims 12 and 21 of the present invention.

Lindley also states that carbon monoxide gas can be present during the plasma treatment (Column 8, Line 22), as recited in claims 2, 10, 13, 16 and 23 of the present invention. Finally, Lindley discloses that the main etch is performed in the same reactor as the photoresist pretreatment, without extinguishing the plasma between the two steps (Column 5, Lines 49-51), as recited in claims 7 and 19 of the present invention. Lindley states that in this type of etch reactor, RF bias power is coupled to a pedestal electrode supporting the wafer to be etched (Column 5, Lines 8-10), which is taken to mean that power is supplied to the bottom of the wafer, as recited in claims 8 and 20 of the present invention. Lindley also states that the RF power increases when transitioning between photoresist pretreatment and the etching process (Column 5, Lines 53-55), as recited in claims 8 and 20 of the present invention. Lindley teaches that the photoresist is stripped by ashing after the etching process is complete (Column

4, Lines 55-57), as recited in claim 15 of the present invention. Lindley also teaches that a deep ultraviolet photoresist is used in the process (Column 2, Lines 22-26).

Lindley fails to disclose that plasma used for the photoresist treatment is formed using a fluorine-free carbon-containing gas, and that an ArF photoresist material is used.

Meyer discloses a pattern forming method comprising: placing a chromium layer onto a substrate, forming a photoresist layer on the chromium layer, exposing and developing the photoresist layer to form a pattern, exposing the photoresist layer to a carbon monoxide plasma to treat the surface of the photoresist layer, patterning the chromium layer by plasma etching, using the patterned photoresist layer as a mask, and removing the patterned photoresist layer (Column 2, Line 39-Column 3, Line 10). Meyer does not state that the carbon monoxide plasma contains fluorine, as recited in claims 1, 9, 12, 15 and 21 of the present invention.

Ma discloses a method for forming via and contact holes with a photoresist comprising imaging a photoresist material using an argon fluoride laser source since a 193 nm source is required (Column 2, Lines 7-11), as recited in claims 1, 9, 12, 15 and 21 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used a fluorine-free carbon-containing gas, as suggested by Meyer, in the process of Lindley because Meyer teaches that this type of treatment enhances the resistance of a resist mask to an etching treatment. It also would have been obvious to one of ordinary skill in the art to have used an ArF photoresist, as

suggested by Ma, in the process of Lindley because Ma teaches that ArF light sources are a common type of deep ultraviolet light used in photolithography processes.

4. Claims 3, 11, 14, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lindley (U.S. Patent 6326307) in view of Meyer (U.S. Patent 4504574) and Ma (U.S. Patent 6830877) as applied to claims 1, 2, 5-10, 12, 13, 15-17, 19-21, and 23 above, and further in view of Ko (U.S. Patent Publication 2003/0129816).

The teachings of Lindley, Meyer and Ma have been discussed in paragraph 3 above.

Lindley, Meyer and Ma fail to disclose that the plasma used in the treatment and etching processes can be generated by carbon dioxide.

Ko discloses a process for increasing silicon-containing photoresist selectivity comprising: providing a substrate with a photoresist placed on top, exposing the photoresist to a light source for patterning (Paragraph 0026), eventually curing the photoresist layer with a plasma, which may be formed by carbon dioxide or carbon monoxide gas (Paragraph 0037), and etching the substrate in an etch chamber (Paragraph 0037).

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have used carbon dioxide to generate a plasma, as suggested by Ko, in the process of Lindley, Meyer and Ma because Ko teaches that carbon dioxide works similarly to carbon monoxide to harden a layer of photoresist so that the photoresist layer is protected against etching.

***Response to Arguments***

5. Applicant's arguments, filed 11/28/2007, with respect to the rejection(s) of claim(s) 1-3, 5-14, 21, 23 and 24, have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, a new ground(s) of rejection is made in view of applicant's amendments to the claims.

6. Applicant's arguments filed 11/28/2007, with respect to the rejection(s) of claim(s) 15-17, 19 and 20, have been fully considered but they are not persuasive.

Applicant argues that Chu, Lindley and Meyer do not teach that an ArF photoresist material is used in the process. The reference, Ma, has been combined with Chu, Lindley and Meyer to teach this missing feature.

Applicant argues that Ma cannot be used to teach the use of an ArF photoresist when combined with Chu, Lindley and Meyer because Ma does not disclose the process of treating a photoresist with a fluorine-free carbon-containing gas. Ma is being used to teach that an ArF light source is a type of deep ultraviolet light, which the references, Chu and Lindley, use in their processes. It would be obvious to combine these references because each reference is teaching a process of patterning a DUV photoresist and each has a step of pretreatment so that a more accurate photoresist pattern is formed. Each reference also teaches a step of etching after patterning the photoresist layer.

***Conclusion***

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP



§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-6545. The examiner can normally be reached on Monday through Friday, 8:30 a.m. - 5:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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/Mark F. Huff/  
Supervisory Patent Examiner, Art Unit 1795